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ABSTRACT

This report presents the proceedings of a regional workshop on the training of secondary school teachers in the use of computers in general education, which was conducted to launch a pilot project for the countries of Europe and stimulate international cooperation in the field. Introductory materials note that the tasks set for workshop participants included the examination of 11 case studies prepared under contract with Unesco; the identification of innovative trends in pre- and in-service training of secondary school teachers in this area; and the development of proposals for regional and international cooperation in the implementation of the regional pilot project for the biennium 1988-1989. The report is divided into three parts: (1) background of the workshop, including objectives, participation, documentation, and organization; (2) the results of the workshop proceedings, including examination of the case studies, strategy guidelines (the needs of the beginner, developing skills, and the informatics-competent teacher), and resource implications; and (3) proposals for regional and international cooperation, including criteria, principles, application area, institutions, and cooperation. Appendixes include a copy of the workshop agenda, a list of participants, the chairman's position paper ("Teacher Training in the Context of a Changing Model of the School" by Rhys Gwyn), a bibliography of participants' papers received, a 94-item supplemental bibliography (of which 35 are in various European languages), and abstracts of 10 of the case studies prepared for Unesco. (EW)

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TRAINING OF SECONDARY SCHOOL TEACHERS IN THE USE OF COMPUTERS

IN GENERAL EDUCATION

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European Regional Workshop organized by EIC-FET and Unesco

Prague, 30 November - 4 December 1987

FINAL REPORT

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F I N A L R E P O R T

Prague

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FINAL REPORT

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F I N A L R E P O R T

1 BACKGROUND OF THE WORKSHOP

1.1 Objectives

Under the Unesco programme on Informatics in Education approved by the 23rd session of the General Conference (Sofia 1985) for the biennium 1986-1987, several regional pilot projects for the training of secondary school teachers in the use of computers in general education have been prepared by the Division of Higher Education and Training of Educational Personnel (Unesco/ED/HEP).

The present Workshop was seen as the first step of the pilot project in Europe region. The meeting was prepared under contract between Unesco/ED/HEP and the European Information Centre for Further Education of Teachers (hereinafter EIC-FET), Charles University, Prague, to launch the regional pilot project and in this way to stimulate international cooperation in the field.

The Workshop had to fulfil the following tasks:

a) to examine 11 case studies prepared under contract with Unesco in several countries on national level or on behalf of some non-governmental international organizations;

b) to identify innovative trends in pre- and in-service training of secondary school teachers in the use of computers in general education;

c) to propose regional and international cooperation in the implementation of the regional pilot project for the biennium 1988-1989.

1.2 Participation

EIC-FET contacted the respective European specialists whose participation had been agreed with Unesco. Some of them were invited in their personal capacities of experts to international organizations and fora such as those to Unesco (R.Cwyn, M.P.Lapchik, V.I.Yefimov), ATEE - Association for Teacher Education in Europe (P.Bollerslev, P.Gorny, R.Gwyn, E.Neuwirth, T.van Weert), IFIP - International Federation for Information Processing (P.Bollerslev), ICCE - International Council for Computers in Education (E.Neuwirth), the Bulgarian permanent fora (some of the above and V.M.Monakhov), etc.

Other specialists were invited on the basis of cooperation of their respective institutions with EIC-FET (D.Pavlov, A.Walat) and/or with Unesco (E.Genzwein, A.Nadási). Unesco was represented by project specialists of the Divisions Unesco/ED/HEP (V.Goryatchev) and Unesco/ED/SCM (P.Gonda), the latter being the Division of Educational Sciences, Contents and Methods of Education.

Taking into account the enormous interest of Czechoslovak educationalists to attend the Workshop, besides the experts invited additional participants with the status of observers were admitted. The experts themselves shared their active participation in the following ways: examining the case studies and presenting the contributions on state of the art in Czechoslovakia

(A.Malach, F.Medek), providing hardware/software facilities and demonstrating programs (J.Fanta, J.Martínek), taking part in drafting conclusions (P.Janota, J.Markvart) and guaranteeing the Workshop programme (H.Procházková).

All those invited participated in the Workshop. In total there were 32 persons, 12 of them coming from 9 European countries (Austria, Bulgaria, Denmark, FRG, Hungary, the Netherlands, Poland, UK, USSR), 2 from the Unesco Secretariat in Paris and 18 from Czechoslovakia. Not included are the EIC-FET staff members and official representatives, namely the Secretary General of the Czechoslovak Commission for Unesco, the Prorector of Charles Univesity, and the Director of EIC-FET (see Appendix 2).

1.3 Documentation

Unesco had contracted the 11 case studies completed during the biennium 1986-1987. Their authors prepared them either on a national level (Australia, Canada, Bulgaria, France, FRG, Hungary, Israel, USSR) or on behalf of an international organization (ATEE, IFIP, ICEM - International Council of Educational Media).

Unesco sent the studies (10 in English, 1 in French) to EIC-FET, which provided the full texts to the experts willing to examine them (P.Bollerslev, P.Gorny, R.Gwyn, A.Malach, F.Medek, E.Neuwirth, T.van Weert) prior to the Workshop. In order to ensure a structured approach to the work the experts were asked to observe the following Terms of Reference set by R.Gwyn:

a) Identify the main structure of the arguments presented;
b) Identify the major emphases in the author's analysis of the implications of information technology for education generally;
c) Identify the main implications presented for teacher education;
d) Refer to any obstacles to progress listed by the author;
e) Refer to any positive factors listed;
f) State the extent of your agreement/disagreement with the arguments presented.

In order to enable the participation in the discussion following the evaluation at the Workshop EIC-FET provided all the participants with 1-2 page abstracts of the 11 case studies in English and Russian versions (see Appendix 4). Moreover the packages prepared by the organizer for the participants comprised essential Workshop documents (List of Participants, Agenda, Social Programme) and also Supplementary Bibliography of literature on the Workshop topic (see Appendix 6).

During the sessions additional documents were disseminated to the participants by EIC-FET, e.g., the Czechoslovak national study on the programme of training educational personnel for the computerization of education; EIC-FET paper on the computer assisted retrieval (CAR) in teacher education data base, as well as those received from many participants (see Appendix 5).

Publications and periodicals concerning the problem area either selected from EIC-FET library or provided by some of the participants were displayed during the Workshop.

1.4 Organization

The Workshop was prepared on the basis of an efficient cooperation established between Unesco/ED/HEP (V.Goryatchev) Paris, EIC-FET (H.Procházková) in Prague and the top expert (R.Gwyn) in Manchester. The latter had been asked to prepare a position paper (see Appendix 3) to chair the workshop sessions and to coordinate team work on concluding documents.

Unesco covered a part of financial expenses of the travels of the experts, provided the case studies as well as several publications and documents edited by Unesco, and ensured the framework of the Workshop within the respective Unesco programme.

EIC-FET organized the regional Workshop in the historical premises of Charles University (those of Karolinum) in Prague. In order to meet the participants' needs the organizer supplied the equipments requested, i.e. a micro-computer of IBM PC type and an overhead projector.

The working language of the meeting was English, supplemented with individual consecutive interpretation from/into Russian on request. A guided excursion to a general secondary school in Prague was arranged for the participants interested to attend informatics lessons and to talk with the staff.

Some of the Workshop sessions were designed as joint meetings with the participants in another Unesco Workshop dealing with a subject application, i.e. "Training of Secondary School Teachers in the Use of Computers in Chemistry Education" organized by EIC-FET in parallel under contract with Unesco/ED/STE Division (of Science, Technical and Environmental Education). The joint discussions and social events were highly appreciated by the participants in the both meetings as a very fruitful exchange of knowledge and approaches to the problems.

2 THE RESULTS OF THE WORKHSOP PROCEEDINGS

The programme of the Workshop concentrated on the above tasks set by Unesco. A group of selected experts devoted to the conceptual work much more effort than could be evident from the Agenda (see Appendix 1).

2.1 Examination of the Case Studies

Evaluative reports were presented by the respective experts (in average two of them per a study) on the basis of their preliminary work. They were followed by a discussion from the floor and by additional comments by Unesco representatives. E.Neuwirth and T.van Weert agreed to be the rapporteurs of this part of the session. On the basis of their summaries a synthesis has been made by R.Gwyn, Chairman, as follows.

Statement of Conclusions

A. In reviewing the outcomes of discussions, participants were unanimous that valuable insights had been gained into the problems faced in all countries in respect of the introduction of the new technologies of information and communication (NICT) into their educational systems.

It was agreed that these problems (which are also creative opportunities) are generalisable across the curriculum. This summary then does not address problems specific to any one subject area; rather it concerns itself with strategies for providing all teachers with a general competence in the use of informatics tools in the classroom.

B. Discussions drew heavily upon the case studies prepared for Unesco and made available to the Workshop. Although these case studies covered a broad spectrum of philosophies and approaches, there was a clear underlying agreement that effective strategies for the training of teachers were a key component of any plan at national level. Participants felt that such strategies were best constructed on the basis of methods of using the computer as an educational tool.

C. The use of the computer should not be seen in isolation from other issues. Its introduction into the classroom raises issues which need to be studied from pedagogical, psychological, sociological and health points of view. However, the rapid penetration of computers into the schools, in response to both nation initiatives and public demand, is such that there is an inevitable gap between everyday practice and the theoretical grounding upon which practice should ideally rest; it is important that this problem be recognized.

D. A strategy seems called for to educate teachers to be competent in the use of educational informatics tools of today; this competence includes the ability to evaluate this use. Teacher education aimed at building up this competence should take into account also that the use of informatics tools is only one aspect of the relation of informatics and education. Other important aspects include the implications of the use of informatics tools, the fact that these tools are embodied in a program produced and executed by means of informatics technology, and the fact that this technology is supported by science. It seems that the professional competence of teachers with regard to the use of educational informatics tools should be based on the fundament of a personal competence with regard to informatics, in particular the use of informatics applications as everyday tools.
One of the problems in defining this competences lies in the fact the term "informatics" itself is used with quite different meanings in education contexts.

E. Workshop participants were mindful of the fact that the formulation of detailed curriculum guidelines is the responsibility of the appropriate national bodies. Furthermore, it is the case that different countries have different experiences of the introduction of information technology into educational practice, and that resourcing strategies and possibilities vary considerably from country to country.

F. It was felt not to be appropriate, therefore, that participants should attempt to draft curriculum guidelines as such. Participants felt that what would be most valuable at this stage, and most useful for distribution to Unesco Member States, would be a set of <u>strategy guidelines</u> for training teachers for the introduction of computers into education. Member States would then be free to examine these guidelines in the context of their own national situations.

G. The strategy guidelines are based on a <u>three-stage analysis of the needs</u>

of the teacher when coming to terms with the possible uses of computers. This three-stage analysis is presented from the perspective of the teacher already in service.
Additionally, the strategy guidelines are supported by an identification of their implications for resource strategies if adopted.

H. As a final preliminary comment it should be added that "secondary teacher" is here defined as a teacher working with the approx. 10 to 18 age range; such a teacher may or may not be specialized in one subject area. For the purpose of the strategy guidelines, these teachers are specifically not teachers of informatics.

2.2 Strategy Guidelines

Stage 1: The Needs of the Beginner

National strategies should recognize the specific needs of teachers who have no prior knowledge of computers and/or their use but who are preparing to take their first steps in this field.

The overall goal of training at this stage is that the teacher should acquire a positive motivation through having a successful first experience.

The following needs should be addressed

a) Teachers should have the opportunity to acquire basis familiarity with machine operations. At this stage, no deep theoretical understanding is needed; the emphasis should be upon practical operations, such as will allow teachers to feel secure in using the equipment.

b) The essential feature of the training strategy is that the teacher should encounter appropriate examples of computer applications. "Appropriate" in this context refers to any application which the teacher can identify as relevant to his/her own interests and needs. These may be personal interests and needs, or they may be professional, e.g. classroom applications. In the long term, the actual content on which this first experience is based may not be important; what is important is that the teacher be enabled to see for him/herself how the computer may serve a useful purpose.

c) The third element of this stage of training is that teachers should be enabled to build up mental models of the overall functions of a computer system. These models should not be at the levels of electronic elements, binary circuitry of processor units (e.g. the arithmetic/logic unit, the instruction processing unit etc.) but on a more global level such as the input and output behaviour, the storage, the processing and retrieval of data oand of the computer as part of a real-time system.
If these three elements of strategy for the first stage are realized, it may still be the case that the teacher lacks some essential components of full understanding. The important goal, however, is that the teacher should emerge from this first stage with a sense of having overcome any psychological barrier, a positive view of the technology and its applications and with sound basis on which to develop further understanding and to build experience.
It is important for motivation that the teacher has the opportunity to move

from this first stage to the second within a relatively short space of time.

Stage 2: Developing Skills

The prerequisite for undertaking stage 2 is completion of stage 1, or having acquired already a personal competence with respect to the use of informatics applications.

The aim of stage 2 is to provide a computer literate teacher or teacher trainee with competence with regard to the professional use of educational computer applications. After finishing stage 2 he or she will be capable of using standard educational applications in his/her subject area. He/she will have a comprehensive overview of the various relevant educational applications of information technology and be able to gather information on these applications from appropriate sources.

The crucial part of the strategy is that the trainee is provided with good working examples of educational applications and the associated methodology. The trainee also should be given ample opportunity to use these applications in actual practice.

The needs of trainees must be addressed. These include:

- a typology of educational applications and a methodological framework to facilitate exchange of ideas. One example of a typology can be found in the paper (Gwyn 87 a). This typology ranges from applications in which information technology tools are used to think with to drill and practice application;
- insight in the relative merits of different materials supporting learning, such as computer programs and written materials;
- ability to judge the appropriateness of the various learning materials for different types of pupils;
- the possibility for exchange of information both in a formal structure (e.g. a national newsletter) and informal.

The needs of the trainees can be met using different models of implementation. One model that can be used is to train the teachers both in a formal course and in actual teaching practice.

In the last case the trainee should be supported by some form of consultancy service. After the training this service should be continued.

It is imperative that appropriate educational software and hardware be available. Educational applications should be fully worked out including supporting materials.

There will be a difference in approach between pre- and in-service teacher training which has to do with the fact that pre-service trainees will not have much practical experience with pupils. However, the aims of stage 2 will be the same in both cases.

At present not enough is known about the methodology associated with educational uses of educational technology. One of the subjects needing to be studied is the possibility of bringing more interdisciplinary aspects into school practice via information technology tools.

Stage 3: The Informatics-competent Teacher

The teacher is in a position where he/she is able to use the NICT with confidence in teaching his/her own subject(s). He/she is convinced that the NICT will enhance the transfer of contents as well as the methodology of teaching the subject(s). Patterns of use of the NICT will stabilize as the teacher develops preferences for particular forms of use.

The aims of stage 3 are:

- to enable the teacher to reexamine his/her own notions about teaching and learning;
- to give him/her possibilities to be free to put more effort into designing engaging learning activities. This means that a teacher will be competent to choose among a variety of educational materials including NICT and combine them in an appropriate way;
- to enable the teacher by the use of NICT to overcome rigid subject boundaries and promote interdisciplinary study;
- to give the teacher the basic elements for engaging in a professional way in the design of educational courseware. This means that for this reason the teacher should be prepared to participate in a cooperation with other teachers, researchers, courseware designers, media specialists and computer specialists.

Naturally these aims have to be adapted according to the underlying cultural conditions, the different school systems as well as the differences in the technical resources. Since teacher students have normally not yet acquired skills in teaching practice the aims described above for the in-service training have to be adapted for pre-service courses.

By realizing stage 3 a shift in role of the teacher from expert to guide and the more direct involvement of students in each other's learning may be expected.

2.3 Resource Implications

It is important that the resource implications of a strategy for the introduction of computers into schools are not under-estimated.

In many countries, attention has focused, quite naturally, on the need to make hardware available. This is certainly a major consideration, and careful thought needs to be given to the level of hardware resource provided. Experience has shown that the use of disk drives, rather than cassette machines, for storage purposes can transform the classroom activities possible, particularly in terms of developing data retrieval skills, and this seems to be a critical step forward in any national strategy. A second, equally important, question is that of the level of processor to be used. Since hardware in schools is expected to have a relatively long life, there is an argument for investing, at the outset of a national strategy, in the most advanced level possible; in five years time, this level will have been overtaken by development but the machines will still be in use. On current technology, this would suggest an investment in 16-bit machines as a minimum, preferable 32-bit. Experience shows also that much more satisfactory work is possible, especially at Secondary level, if machines have at least 520K of memory.

A second major implication for resourcing is that suitable software is

needed. This is an extremely important factor, but it needs to be put into perspective. On the view that computers should be used as tools in education, it is not in fact necessary to produce a very large range of software specific to each and every subject area. A very great deal of progress can be made, in highly appropriate directions, with software that is generalisable across the curriculum. That is to say that the basic applications needed are a good word processing package, a straightforward but powerful database and a spreadsheet capable of supporting a range of uses from the simple to the relatively complex. If these can be supported by graphics packages and examples of one or two languages suitable for educational use (LOGO and PROLOG for example) then a very sound basis will have been established. In fact, all of the items mentioned here exist already in forms suitable for educational use and there is no need to invest heavily in new development.

The third implication is the one mentioned in the main text of this paper: teacher training. There is evidence to suggest that expenditure in this area is both more important, and greater in monetary terms, than expenditure on hardware. Moreover, as the technology advances, so it is necessary to see teacher in-service training as a renewable activity if teachers are to keep pace with ever-improving levels of provision. This element of the strategy requires very careful planning.

Finally, it is suggested that development in all of these areas should be supported by a parallel research activity, focused upon the pedagogical, sociological, psychological and health aspects of the use of computers in schools. Currently this is a neglected area and it is hoped that future strategies will be more responsive to this need.

CONCLUSION

Participants at the Workshop expressed their conviction of the value of such international exchanges of views and experiences and their belief that every effort should be made to continue such dialogues. In the following Section, a proposal to this effect is presented.

All participants at the Workshop expressed their very warm thanks to the EIC-FET, its Director and staff for making the Workshop possible, and to Unesco for its generous support. It was felt that the Workshop had contributed greatly to cooperation in this highly important educational field.

3 Proposals for Regional and International Cooperation

Recommendation to the Director-General of Unesco for possible pilot projects (1988-1989) in the field of the NICT in teacher education:

Participants, on the European regional basis, discussed proposals for possible pilot projects in the field of the NICT in education, which might be seen as a follow-up to the Workshop. It was assumed that, normally, such projects would involve the active participation of some four or five European teacher training institutions.

3.1 The following criteria whereby proposals might be selected suggested:

a) The institutions should have an existing commitment to, and experience of, the use of computers in teacher education.

b) Projects should not be subject-specific but should focus upon applications with a potential for use across a wide range of curriculum activities.

c) Applications selected for projects development should be such as to allow for extension of present understanding, but shoul not depend upon advanced hardware. It is essential that the outcomes of a project should be of value to Member States which may not be at the same stage of development as participating countries, but which are progressing towards that stage.

3.2 It is suggested that, irrespective of the application focus selected for a pilot project, the following principles be adopted:

a) Participating institutions should develop and test curricula and methodologies for using selected application(s) in teacher education.

b) Support materials and documentation should also be developed and tested.

c) Statements of methodologies and curricula, and copies of materials and documentation, should be exchanged between participating institutions for purposes of comparative trialling.

d) A synthesis of outcomes of comparative trialling should be prepared. If possible within budgetary constraints, a Unesco Workshop within the 1988-1989 programme should have the opportunity of exchanging in depth this synthesis and all materials upon which it is based.

e) The outcomes of the project should be made accessible to all interested bodies in Member States.

f) To avoid obsolence of findings, the time-span of the project, from starting to availability of outcomes, should not be more than fifteen months.

3.3 The following application areas are suggested as meeting criteria set out above (sub 3.2):

a) The computer [1] and information processing. In this area, institutions would work upon, for example, databases and spreadsheets as tools for information processing across a range of curriculum activities. Curricula and materials produced would support teachers in acquiring a sound methodology of using these tools in different curriculum areas.

b) The computer and language development. A project in this area would focus on a range of curriculum tools, which would include text-processors, desk-top publishing packages, ideas outliners and viewdata simulators. The emphasis would be on enhancing understanding of the contribution these tools can bring to both mother tongue and foreign language acquisition.

c) The computer as measurement and control device. This project would focus upon a range of different ways in which the computer may be used in classroom situations working quantitative analysis of the environment. A wide range of applications would be examined, from remote sensing devices (e.g., weather data from satelite) and robot control to the processing of data collected manually (e.g. questionnaries and surveys).

Note: Two or more of these focuses might be combined - for example a) and b), a) and c).

3.4 It is suggested that this recommendation be communicated to institutions wishing to participate in the pilot project.

Those institutions should use the text of the recommendation as a guideline to the formulation of a proposal.

3.5 It is suggested that Unesco/ED/HEP Division cooperate with EIC-FET in Prague in the following ways:

a) promote its computerized documentation activity to assist the international exchange of information on teacher training in the use of computers;

b) initiate a follow-up Workshop to be organized by EIC-FET in Prague in 1989 to evaluate the implementation of the pilot project.

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1) "Computer" is here used as a shorthand term for the range of NICT available for classroom use.

TRAINING OF SECONDARY SCHOOL TEACHERS IN THE USE OF COMPUTERS IN GENERAL EDUCATION

European Regional Workshop organized by the European Information Centre for Further Education of Teachers, Charles University, and Unesco
Prague, 30 November - 4 December 1987

AGENDA

Nov. 30 Mon	p.m.	arrivals
	ev.	informal meeting of the European experts
Dec. 1 Tue	a.m.	joint opening session . addresses of the representatives of Unesco, Czechoslovak Commission for Unesco, Charles University, EIC-FET . "Current Advances in Information Technology and their Implication for our Models of School", a position paper by Rhys Gwyn
	p.m.	expert meeting . examination of case studies contracted by Unesco by P.Bollerslev (Denmark), P.Gorny (the FRG), R.Gwyn (the UK), F.Medek (Czechoslovakia), E.Neuwirth (Austria), T.van Weert (the Netherlands) . highlights from each paper
Dec. 2 Wed	a.m.	joint session with the Chemistry Workshop . exchange of experience . discussion on training teachers for general/subject application
	p.m.	expert meeting . the presentation and evaluation of the participants' national and/or international results and materials . display of software oriented to the Workshop aims
Dec. 3 Thur	a.m.	expert meeting . discussion on the range of the applications of information technology across the curriculum incl. the implications for teacher training . deriving trends and topics
	p.m.	. preparing a model training programme for teachers
Dec. 4 Fri	a.m.	expert meeting . drafting final documents joint concluding session
	p.m.	departures

Appendix 2

TRAINING OF SECONDARY SCHOOL TEACHERS IN THE USE OF COMPUTERS IN GENERAL EDUCATION

European Regional Workshop organized by the European Information Centre for Further Education of Teachers, Charles University, and Unesco
Prague, 30 November - 4 December 1987

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TEACHER TRAINING IN THE CONTEXT OF A CHANGING MODEL OF SCHOOL

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Summary

This paper has been produced as a keynote input to discussion at the above seminar. It refers to a further paper, appended to this, which describes an R&D project in teacher training, the PLUTO Network, in which the author and other Seminar participants are involved.

PLUTO is a network project, which will link together electronically for developmental purposes institutions of teacher training in some eight European countries; this number may be added to in the near future. The paper suggests that through this and similar instances of educational development based on the exploration of the NICT (new information and communication technologies) in education, we begin to see the emergence of possible new models of school.

It is not the aim of the paper to make predictions, nor is the principle of technological determinism accepted. What is argued is that, in a period of rapid technology change, it is essential to identify the lines of possible development so that informed choices can be made as to which of these lines are educationally and social acceptable, as well as to what are their resourcing implications in human and material terms.

1. INTRODUCTION

This is a relatively brief paper, designed to stimulate discussion. It has been written for a specific purpose at the 1987 Prague Seminar, namely to ensure that, from the outset, debate at the Seminar acknowledges that there are very wide-ranging issues which have to be faced as we measure up to the challenges of the new technologies for the training of teachers. To focus too narrowly upon the current state of machine or software development is to run the risk of missing these issues. Thus the paper is speculative about possible developments which may come about in the nature of school as an institution as a consequence of the increasing adoption, both inside school and out, of the NICT, and about the further implications of such change for the education and training of teachers.

This does not mean to say that the paper attempts to make specific predictions. It seems profoundly erroneous to assume that, because a particular technology or cluster of technologies is capable of leading to a given outcome, it must necessarily lead to that outcome. This is the fallacy of technological determinism - a fallacy because the consequences of technology advance do not depend on the features of the technology alone but rather upon the social, political and economic factors which mediate the take-up of the technology. Indeed, more than one writer (Weizenbaum 1987, Shallis 1985, Rozak 1986) has pointed firmly to the need to understand what the technologies are capable of precisely so that we, the humans who create them, have at least a chance of controlling their influence upon the way we live.

For in denying technological determinism, we must not make the even more naieve error of believing that technology has no influence on our lives. Clearly it has. If we say that technology development does not lead necessarily to any given outcome in the social, economic or cultural spheres, we have also to recognise the other side of the coin, which is that technology change does inevitably bring with it some measure of change in these spheres. It is this that is the challenge. To attempt to make precise predictions about the future is a childish exercise, open to far too many variables ever to be a satisfactory process. But to identify the broad possibilities for change is far from futile; it is a necessary exercise and the only way in which we can control our collective destinies. This too is an area in which many writers have offered scenarios. In one of the earliest - and still most far-sighted - of the major statements about the long-term implications of NICT, Nora and Minc (1978) suggested that no existing economic system would fail to be transformed; Masuda (1980) has put forward a visionary view of a world transformed by the NICT; Mackintosh, in a study which has gained wide acceptance, has argued that the future of Western Economies depends on their ability to adapt to the new technologies (Mackintosh 1986). In the UK, in-depth analyses of the views of planners, commissioned by the National Economic Development Office (Bessant et al. 1985, 1986)

found a range of predictions about future development linked by one underlying agreement, to the effect that, whatever the precise nature of the socio-economic changes triggered by the NICT, they will be nothing short of revolutionary. The potential challenge is enormous.

If we are to begin to grapple, conceptually that is, with this challenge, we have to realise that technology development has to be assessed, not as technology per se but in terms of its indirect effects. Obvious illustrations abound from previous epochs: it was of little consequence, for example, for anyone but those who became workers in the print trade precisely what sort of printing machine was developed by Guttenberg. What was far more important was the implications of his invention for mass literacy, for education, for the emergence of the news media - for the ways, in short, in which it changed the nature and internal functioning of society. In the early days of television, more than one technology was under development. It matters very little which was finally adopted; what does matter is the impact of television measured in terms of informal learning, of heightened social and political awareness, of our shared realisation (one thinks of the world response to the Ethiopian famine) that we do all inhabit the same globe. And, to take a final example: it matters little what makes of computer are currently installed in the Stock Markets of the Western economies; it matters very greatly that, in the autumn of 1987, they very nearly triggered a world financial collapse which might have had catastrophic consequences.

It seems necessary, then, that when we attempt to construct some sort of speculative focus on the school of the future, its teachers, its internal functioning and its relationship to the society which it serves, we must look for the indirect and not the direct consequences of the technologies. If we are to think about schools and teachers which will serve the educational needs of, say, the year 2025, it is of little matter precisely what microcomputer we may or may not be using in 1987.

Of course, we do have a number of precedents to guide us. There are a great many technology advances which, one way or another, have contributed indirectly but importantly to the nature of school as we know it, and to the role of the teacher in that school.

II. TECHNOLOGY AND THE SCHOOL - SOME ANTECEDENTS

It is probably helpful to recognise that certain constraints built into our concepts of 'school' and 'teacher' are very ancient indeed. Since before Socrates we have relied overwhelmingly on one agency, namely the capacity of the individual called the teacher to communicate with a group of learners called a class. (The image of the teacher, indeed, is one of the most powerful myth images in the human pantheon.) The size and location of the class, the length of a lesson, the rules which govern the interaction: all of these have varied from one place and time to another but always within the constraints established by what is physically possible in terms of communication between one and many. It is this human process of communication and the constraints upon it which together, through

countless generations, have created the image of the teacher as the mediator, the arbiter of what it is the learner learns; indeed, it is interesting to note how powerfully this ancient image had conditioned the functioning of even a technology-based institution such as the UK Open University.

Only in comparatively recent times has it become possible, slowly, to distinguish the process of learning from the process of teaching, to begin to see the learner separately from the teacher; in so doing, we have learned slowly to rethink some of our ideas about teacher training. Largely this has become possible through technology advance.

Historically, the first major technological breakthrough, clearly, was printing, which greatly extended the possibilities whereby learners could learn independently of the teacher; sadly, one can scarcely argue that we have yet found the key to producing generations of school children who are really able to read, not in the effective sense of the term. The truly independent learner has existed from time immemorial but is still, sadly, a relatively rare animal.

There are perhaps two observations worth making about the book as a resource for learning. First, no matter how well the book is written, it is still a passive resource. The user must be able, or learn to be able, to extract from it what it is that it has to offer. Second, although the book is itself a powerful myth-object, because it is passive, in schools (and it is important to stress here that this paper is concerned with schools as the places where teaching and learning are institutionalised) it has been over-shadowed by that other powerful myth figure to which we have alluded already, namely the teacher. Almost invariably, what the child learns from the book is what is selected for learning by the teacher (or by the syllabus or by the State, etc.). The fact that a great many children do go on to learn from books more than what teacher selects is almost an accident; very few teachers succeed, or perhaps even attempt, to instill in pupils first and foremost the ability to read and learn independently. This is not surprising, since to do so would be to undermine not only the teacher's own role but also to sell short on the socialisation process demanded of school. As a technology, the book is still vastly under-exploited in the compulsory cycles of education.

But more recent technology advances have had other impacts upon the relative balances of the roles of teacher and learner. Television is a case in point. It is clear that educational television has had a great deal to offer by way of disseminating a high-quality learning resource to a great many pupils at one time. But if we are really to assess the impact of television upon teaching and learning, then what we must look to is not educational television per se but television generally: news, current affairs and above all the vast gamut of entertainment so readily available. Television has created a mechanism for instant and large-scale dissemination of information and views which is quite without parallel in earlier times and which

accounts - to an extent which defies quantification - for a large proportion of the 'real' learning of most children. As a consequence, the myth of the teacher as the arbiter of the known has been eroded. Teacher becomes just one among the many experts - and some far more expert - who form part of the child's everyday world. Moreover, teacher's attitudes and values are measured against other attitudes and values, often far more attractively presented. The myth is weakened; technology has shifted the balance from the power wielded by the teacher and in the direction of the self-sufficiency of the learner.

But if technology has brought about this shift in the transaction of teacher and pupil which is at the very heart of the business of schooling, it has also brought about other shifts, equally important but even less direct. I have argued elsewhere (Gwyn 1986) that, for example, one clear consequence of technology advance in the late eighteenth century in England was the emergence of the great cities of the following century, and that these, in turn, created a wholly new kind of school, namely the large urban institution which both served the employment needs of a technology-based economy and was moulded by the political forces emerging from that economy. The schools of Victorian England were not run by steam-engines or by spinning-jennies, but they were what they were as a consequence of what the steam engine and the spinning-jenny did to and for the economy of the country, and hence also to and for its social structure. School changed. It had previously been either the training place for the young gentlemen who were destined to rule the country by virtue of birth and wealth or the small community institution providing the very rudiments of education to children before they became wage-earners. After the technology advance of the Industrial Revolution, school was set on the road to becoming what it is today - but it was so set as a consequence of the indirect, not the direct, effects of that advance.

These are but a few examples, illustrative only, of the general thesis put forward here. The subject is, indeed, too vast to cover in what is only meant as a keynote paper, and all that can be offered here are a few pointers for reflection. Nonetheless, the reflection is essential if we are not to lose sight of our rapidly-evolving educational futures. To summarise, then, these pointers include the suggestions that, if historical precedent is anything to go by, then:

- although we cannot predict precisely what change the NICT will bring about in the nature of school and in the teacher role, we can be certain that some changes will be brought about,
- these changes are likely to be indirect rather than direct,
- they are likely to continue, and perhaps accelerate, the historic shift from the teaching emphasis to the learning emphasis,
- and, finally, that as changes they are likely to be greater rather than lesser.

III. THE NEW TECHNOLOGIES

It is impossible to deal adequately with any one of these suggestions in one short paper. A full exploration of the implications of the NICT for education will take us many years yet. Briefly, that exploration will need to concern itself with three focuses, which have been identified already within the discussions of the NICT Group of the Association for Teacher Education in Europe.

A. In the first place, it will be necessary to explore in depth the changes that will be brought about in the teaching-learning process - the classroom transaction - as we introduce fully (as we have not yet succeeded in doing) the processing power of the technology in partnership with the intellectual powers of pupils and teachers.

B. Secondly, we shall need to see in what ways the NICT will offer new possibilities for structuring access to learning - what changes, in effect, we may expect to see in school as an institution.

C. Third, we shall need to take into account changes in the social, economic, political and even cultural structures of the society for which we educate our pupils. This is the most difficult area of all so far as constructing scenarios is concerned.

The range of issues raised is fascinating, and I have touched upon some of them elsewhere (in Johnston and Sasson 1986, Gwyn 1987). Under the first heading, for example, we have as yet barely begun to examine the potential of Intelligent Knowledge-based Systems (IKBS) for classroom use; under the third, we are forced to consider (at least in the Western economies) the extent to which the myth of full employment, which has underpinned the whole raison d'etre of the school since at least the first Industrial Revolution, must finally be laid to rest. And these examples are but the tiny fraction of the total picture; there is nothing about school or about teaching, in fact, which does not have to be re-thought in the light of the new technologies.

What may be useful in this Seminar is to focus on one specific illustration. Annexed to this paper is a description of the PLUTO Project, which networks teacher training institutions and schools in a number of European countries. The Project is in its infancy, but it demonstrates what the new technologies make possible, as well as what skills need to be introduced into teacher training.

In the first place, it involves students and school pupils directly in information processing work. The intention is that classes in the training institutions and the schools will engage upon jointly agreed tasks, working to shared database formats. Thus learners in different countries will themselves be working out and agreeing information structures; they will be engaged in the tasks of data capture, data exchange and data interpretation, on a comparative basis.

To make the system work for them, they will acquire the skills of

communication by electronic means - by electronic mail, electronic file transfer and the construction of shared videotex systems. In addition, they will also develop skills of electronic or desk-top publishing, the intention being that classes in different countries will act as 'foreign correspondents' for each other's class magazines and newspapers. They will acquire, in short, skills of the kinds which will be central to living and working in an information era.

But to say this is to identify only the mechanisms of the PLUTO Project. Its long-term implications, it is firmly believed, are more far-reaching. The essential point is that, by the use of relatively instantaneous electronic exchange, classes hundreds and even thousands of miles apart become active resources for each other's learning. This is perhaps the key point about the PLUTO experiment. Certainly there is nothing new about co-operation between classes over distance. But generally in the past, such collaboration has depended upon surface and air mail, with all the delays that those systems involve. What the NICT offer is relatively instantaneous, live, contact of class with class in active collaboration. Drawing upon this facility, then, PLUTO becomes an exercise in opening out the walls of the classroom, an exercise in collaborative learning across distance. It will be clear that the implications of such a development go far beyond the exigencies of teaching and learning, say, Geography or Environmental Studies, highly important though these are. The more important implication is the creation of an electronic global village for education. If this project can be made to succeed, then - and it is no more than a prototype - it has major implications for learner collaboration across cultures and across all man-made barriers. Equally clearly, it has major implications for teacher training.

It is, as we say, only a prototype but it points the way ahead to the kind of change in the model of school which we may expect from the full utilisation of the NICT. PLUTO points to a model in which the learning which takes place is not mediated by any one teacher alone, by any one education system alone or even by any one culture alone. It points to a school the walls of which are electronically open and where learning becomes a collaborative activity with other students, other teachers, other cultures on - so far as the technology is concerned - the global scale.

It is a model which I here sketch in only lightly, in the belief that discussion at the Prague Seminar is the best vehicle for teasing out its full implications. It is just one small illustration of the ways in which, I firmly believe, the NICT require us to rethink quite radically the nature of school, its internal processes and its socio-political-economic setting. A small illustration, but one which, surely, is remarkably in tune with the spirit of collaboration between peoples which is the goal of UNESCO and the hallmark of the work done on behalf of UNESCO by the European Information Centre for the Further Education of Teachers, at the Charles University of Prague.

I have said that such a model of school has sweeping implications for

the training that we give to teachers both pre-service and in-service. It may be helpful, as a final comment, to expand briefly on this statement.

In emphasising the importance of the Industrial Revolution in shaping school as we know it today in the UK, I am implicitly accepting the point of view that sees that school as modelled upon yet another myth-object, namely the factory. This was in many ways the dominant institutional model of the Nineteenth Century, and indeed it remained so until relatively recent times. Within the framework of school as factory, the teacher has fulfilled a range of functions remarkably similar to those of factory personnel, among them the function of overseer, process controller, quality controller. The comparison is a crude one, admittedly, but it is also fundamentally accurate.

As the large factory declines in economic importance new models of economic organisation become important. Among them is the model of the network, of activities linked and integrated into a meaningful whole, but which are physically remote from one another. I put it forward as a personal view that this model of organised human activity is set to take over from that of the factory as the model which dominates socio-economic development into the early years of the next century.

If this proves to be the case - and I am not alone in the prediction - then the chances are high that school, in its turn, will be influenced by the new model. Such a development, surely, would be one to be welcomed: networks, by definition, are holistic activities which emphasise the need for all contributors to function together for the common good. In this sense, the growth of the network idea parallels our growing consciousness about, for example, the natural environment as well as about the political and economic inter-dependence of the peoples of the world. Thus while re-iterating my belief that precise predictions about the future are not possible, I wish at the same time to state my belief that projects such as PLUTO point us very firmly towards the school of the future.

And therefore towards the teacher of the future: a teacher who will not be the fount of all received wisdom, but who will need to have been trained to access the limitless learning resource which the NICT makes available to pupils and who will be, above all, a collaborator with other teachers across the global network in making learning experiences possible for pupils. If we are to bring that teacher into being, then we have to think very hard about the training required.

I hope that discussion at the Prague Seminar will enable us to clarify our thinking on the nature of that training, on the changes that we have to make in our present practice, and on the implications for research and for resourcing.

Didsbury, Manchester
November 1987

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ABSTRACTS OF CASE STUDIES PROVIDED BY UNESCO

BARTA, Ben-Zion (Ministry of Education and Culture, Jerusalem, Israel)
Impact of the penetration of informatics into the education on the training of educational personnel. The Israeli scene. May 1987. 18 p.

The introductory part of the Israeli report describes the general progress in computer technology development regarding the technical possibilities, availability and, consequently, its penetration into nearly all fields of human activity. It also delimits the scope of the subsequent parts of the report and gives the highest importance to the teacher's assistance in educational process instead of computer alone. The irreplaceable role of human educator is highlighted.

The second part describes the environment and national strategy on computers in education in Israel in the framework of the general organization of Israeli educational system. In this environment, the present goals for the educational computing activities are summarized as follows:

- informatics, computer science, applications
- enhancement of the teaching/learning process
- gathering, organizing, presenting, processing information
- general and specific educational management.

These goals are detailed in both contents and approach. Also, the ways of realization of the above-mentioned goals are presented. When referring to the goals of educational computing activities, not only the variety of activities but also a vast range of student population dealt with are concerned. The important thing discussed is the computer equipment in schools. Some statistical data are given about the number of available computers and their distribution in different levels of the Israeli educational system. Information is given about the ways of how computers are located and used. Next, two basic stages of introducing computers into the teaching/learning process and of educational administration applications are characterized:

- preliminary stage intended for testing ideas and technology usually at rather small scale
- implementation stage on the large/full scale.

Both stages are more detailed and explained in the subsequent text along with the classification of personnel having different levels of responsibility and requiring various levels of competence. Also the involvement and the re-

quirements for training the existing staff are described. The Israeli experience shows that there is at least one person who has to be trained and appointed to fulfil a special new task within a school to ensure the effective use of computers - educational computing coordinator whose duties are also described.

The next parts of the report outline the contents of educational staff development including the goals of the training that is considered as modular. The contents of such modules is detailed in the rest of the chapter.

The last chapter deals with the organization of training in two basic forms: pre-service and in-service. Considerations are presented with regard to the contents and goals of both forms of training, as well as educational institutions responsible for them.

The report finishes with final remarks that summarize the aspects connected with computers and their use in society and the strategy of solving the consequences and implications of this inevitable development.

ROZOV, V.K. - LAPČIK, M.R. - JEFIMOV, V.I. (Ministry of Education of the USSR, Moscow; College of Education, Omsk, the USSR)
A study on the state and prospects of educational personnel training in the USSR with reference to the introduction of informatics and computing machinery in general education. 19 p.

In the USSR the first steps in teaching students to program were made at the end of the 50´s. Based on this introductory experience, vocational training groups were established in schools with extended tuition of mathematics and computer programming. Later on, the system of training was also introduced into secondary vocational schools and comprehensive schools in the form of optional courses that were, however, strongly dependent upon computers available and on teacher´s enthusiasm and self-education. Nevertheless, this experience proved to be essential for further development in this field. In the framework of the 1984 educational reform programme, new subject "Introduction into informatics and computing machinery" was introduced in all secondary general education institutions.

The next part of the Soviet study describes the objectives of the national programme of informatics and computer science:

- to achieve mass computer literacy of young people by efficient assimilation of the elements of science and training before entering real life
- to increase the efficiency of the education and training system on the basis of new informatics technology
- to perfect the management of public education based on wide-scale employment of computers and thus making education an integral part of the unified system of introducing informatics into society.

In connection with these objectives, specific factors are discussed in the next part of the study regarding the teacher´s specialized education and training and computer equipment available according to specifications given by the Ministry of Education. The programme is divided into three stages. In the course of the first stage, the completely equipped computer classroom will be available at least in one third of schools. At the same time, the scientific criteria on computer methods of education regarding all the respective aspects will be determined along with the most efficient forms of organization and methods of using computers. The second stage is conditioned by

BRAUER, Wilfried (Technische Universität, München, FRG) on behalf of the Technical Committee "Education" of the International Federation for Information Processing (IFIP)
The impact on educational personnel training of the introduction of informatics in general education. Study prepared for Unesco. April 1987. 16 p. - Bibl.
Appendix: BÖSLER, Ulrich (IPN - Institute for Science Education, Kiel, FRG)
Computer knowledge for all pupils. A curriculum and elements of teacher training. 10 p. - Bibl.

In its preface, the IFIP report sets a framework for subsequent considerations and conclusions regarding informatics as a new basic science created with the invention of computers. The stress is laid on its all-prevading impact on human society through the new technologies it uses. The report also gives the basic principles which are to be reflected in education of informatics:

- teaching about informatics
- teaching by using concepts, methods, techniques of informatics
- teaching with the aid of tools based on informatics
- learning with the aid of tools originating from informatics
- using informatics' tools for daily work of the teacher at school and at home.

The preface reports also some aspects necessary for the development of a good strategy for the training of educational personnel conditioned by the existence of two conflicting parameters - quality and time. From a pure qualitative point of view only a top-down approach makes sense:

- to develop competence at teacher training institutions
- to train all teacher students the appropriate amount of informatics
- to introduce informatics at schools according to the availability of these new teachers.

Obviously, this takes too much time. From the quality-time relation, new forms of initial and in-service education as well as of lifelong self-instruction have to be developed for the education of teachers.

The next chapter of the report deals with the aspects of introduction of informatics in general education from a new view conditioned by the existence of informatics. Considerations are contained here as to new concepts and

methods of their realization and interpretation by means of informatics and use of computers. It is important for children at school and people in everyday life to develop their informatical view of the world, i.e. to have a basic knowledge of informatics. It is emphasized that there are two other domains, in addition to the traditional ones, where informatics will play an important role in the sense that informatics concepts, methods, techniques and tools can contribute to teaching and learning:

- language (general linguistics as well as specific languages)
- knowledge retrieval and acquisition and reasoning.

Considering the problem of teaching in the information age, the report gives some principles that are formulated in an informatics education project along with its objectives and methods:

- to develop teacher´s objective attitude to informatics based on knowledge and experience, and its impact on society
- to develop teacher´s ability to apply concepts, methods, techniques and tools of informatics in teaching his/her own discipline
- to develop teacher´s willingness to use informatics tools for his/her own work in school and at home
- to develop pedagogical criteria for the use of informatics in school
- to retain competence in informatics by teacher´s continuing self-education.

In addition to these objectives, the stress is laid also on the ability of teachers to do practical work. Some considerations are made with regard to the special impact of informatics and using computers on children and parents with and without knowledge of informatcis, on boys and girls and their attitudes to thinking and work in the computer and information age.

The report´s next chapters contain a list of teacher´s musts in the relation to introductory informatics courses for all children and forms of their leading. There is one very important general value of informatics which the teacher has to understand and be able to convey to the children: not only the seacrh for solution but also the process of its implementing for practical use is a very interesting, motivating and rewarding intellectual activity. The computer use in school administration in shortly mentioned and strategic con-

siderations of ways and means of teacher training are explained within the broader social framework, e.g. the problems of in-service training and their solution exemplified by the practice in West Germany and problems of the initial teacher training. In this context, the interdisciplinary nature in applying informatics is emphasized.

The concluding remarks on soft- and hardware and on the introduction of informatics in general education present problems connected with the quality and quantity of soft- and hardware the schools are equipped with. The reasons for schools not being equipped well and the consequences of such a state are discussed and some recommendations as to the soft- and hardware availability and schemes of the computer employment are given.

The joint FRG report "Computer knowledge for all pupils" gives a survey of proposals and recommendations for teacher training and the development of syllabi of computer literacy. At its beginning, the report describes the educational system in the FRG including the history of educational reforms. Then, the survey of how many schools are equipped with computers is given. This is intended as the basic framework for giving information on optional informatics courses and the proposed nation-wide system of relevant education research promoted by different instituions. Presented are recommendations as to the curriculum of computer literacy and its realization in a large pilot experiment. Also the in-service teacher training system for all schools is described. The final part of the report contains prospects for widening and further development of teacher and student education.

Both reports are accompanied with a bibliography.

EGNATOFF, William J. (Faculty of Education, Queen's University at Kingston, Canada)

Teacher education for the information age: an Ontario perspective. Paper prepared under contract with Unesco. May 1987. 26 p. - Bibl.

The introduction to this report gives a historical survey of the employment of informatics and its penetration into social life in Canada. Also Canadians contributions to an international study on the theme "New Technologies in Education" are mentioned. In addition to this, the beginnig of practical experiments with using computers along with a planning practice are described. Some statistical data about progress in number of available computers are given. The report is divided into two major sections:

- Informatic Media in Education
- Informatic Media and Teacher Education.

The first part of the report describes the form and function of informatic media supplemented with examples of the use of the new media in order to enrich the culture. Also an overview of resources available in Canadian schools is given (Ontarion as a representative) illustrated again by examples to enlight current patterns of use of the technology and to suggest how those patterns are shifting as the access to the technology increases. It is argued that in the near future, teachers will need to become more adept at shaping the contents of new media to suit their curricula, and will need less technical knowledge of hardware and software.

The second part of this report suggests to replace the term "training" with the terms "teacher education" or "professional development" as more appropriate to denote the ongoing preparation of teachers to use informatic media. The part presents different ways of how to educate teachers according to their specialization and of the successful integration of computers in the curriculum. The individual sections of the report deal with approaches to teacher education in Canada (Ontario as a representative), where a climate of change has been set by the initiatives of the government and leading educators. The knowledge of informatic media that teachers need and the stages they go through in acquiring that knowledge are outlined. Examples are given of promising mechanism for pre-service teacher education and ongoing professional development. Emphasis is placed on teachers' learning to use the new media

to create adaptive environments which promote learning through social interaction, individual exploration, and creative and technical expression. It is argued that teachers are willing to change, and can do so with sufficient support.

At the conclusion of the report it is stated that public education will change as informatic media play an increasingly critical role in all sectors of the Canadian economy which is now based predominantly on services. The change in education will come about in part because children and youth will bring to school sophisticated knowledge of living in an information age. The change may also come from the results of strategic planning for the use of the new media as tools of learning and personal expression and the concomitant shifts in the role of the teacher. Schools will continue to prepare and sort students for various occupational paths, but it is hoped that they will also prepare students for their lifelong education.

The report is accompanied with bibliographic references.

GENZWEIN, Ferenc (National Centre for Educational Technology, Hungary)
The impact on educational personnel training of the introduction of informatics in general education. June 1987. 24 p. - 2 attachments.

The introductory part of the report contains a brief recapitulation of the changes in technology and especially in microelectronics, and their implications in the life of human society e.g. a basic demand to have masses of people with a developed logical skill. It emphasizes that the appearance of informatics in general education schools does not mean that the students should be trained to become specialists in computers, telecommunications or electronics: a general training is developed in order to give the students a general culture.

The second part of the Hungarian report is devoted to the description of the state of computer education in Hungary. In Hungary today all secondary schools have personal computers. Some 10% of students of these schools learn to program. Supplying computers to general schools has started as well. At the end of 1986 there were 15,000 computers in the schools, and this figure will be increased, as planned, by 10,000 annually. The educational staff is very diversified as to the level of knowledge and willingness to accept new information, knowledge and skills. The instituions responsible for training teachers have, first of all, to educate the front men who will put into practice the educational concept comprehensively developing student's personality. There are some conclusions made on the basis of the analysis of the hitherto obtained experience. Substantial proposals are put forward as to the research of the possibilities and methods of using computers in educational process in two areas: the computer as a medium and the computer as a tool. The hope is expressed that the results of the research will contribute significantly to meeting the actual requirements and avoiding mistakes of previous educational reforms.

The next part of the report highlights some dnagers in propagating informatics devices given by the unequality of financial resources. It further focuses the problem of unequal acceptance of new information and knowledge by boys and girls and their strong motivation in playing with computers.

The fourth chapter deals with the aspects of training teachers and the results and objectives of the training.

The report is accompanied with two appendices containing the information training programme for teachers including the curriculum and thematic areas of computer-aided extension programme of informatics.

GWYN, Rhys (Centre for Information Technology and Education, Manchester Polytechnic, Manchester, the UK) on behalf of Information Technology Group of the Association for Teacher Education in Europe /ATEE/.
Information technology and education. A report prepared for Division of Educational Sciences of Unesco. 41 p. - Bibl.

At the beginning of this report a background of collaboration of members of the IT Study Group of the Association for Teacher Education in Europe (ATEE) on the construction of educational responses to the challenges and opportunities of the new information and communication technologies (NICT) is presented. There are four conclusions that the Group has come to:

- the teacher education and training is very important
- the nature of the training required is substantial
- the training of all teachers is very important
- the education is an important tool for removing socio-economic imbalance between developed and developing countries.

The report goes on with an analysis of what is meant by computer literacy for all teachers. The conclusion of this analysis is that it is important to move away from the automatic association of computer use with the ability to program. Instead, it is necessary to move towards a concept of the teacher as an "intelligent user" of the new technology. This concept is the basis for all subsequent considerations that lead to the conclusion that there are four broad areas of knowledge about information technology (IT) which all teachers and all students should have:

- understanding of the social impacts of IT
- understanding of and practical skills with application of software
- a basic understanding of problem solving by algorithmic means
- some knowledge of the architecture of IT systems.

The Group concludes that it is possible to identify four categories of educational use of IT which were the following:

- learning about IT
- learning with the aid of IT
- learning by means of IT
- IT as an aid to school management.

The report comprises an analysis of the different kinds of NICT applications available to education. The six categories of the NICT potential are identified as follows: the new technologies make possible

- tools for thinkning with
- tools for organizing information
- resources for teaching and learning
- guided discovery learning
- tutorial software
- drill and practice.

The report contains some further comments on each of the six identified categories. After this analysis and comments the report examines other aspects of the NICT considered as a resource for the teacher, the implications for the education and training of teachers, and the implications also for hardware provision and for software development. There are many ways in which the NICT can be of value to the teacher outside classroom activity. The report presents four illustrations of such possibilities:

- resources for personal development
- resources for preparation
- progress monitoring
- administrative support.

As before, the report presents the comments on each of these possibilities. There are two points which need to be emphasized as implications for training:

- the importance of pedagogical training
- the importance of attitude training.

Both points are discussed and illustrated in the report along with additional three factors:

- in-service and pre-service training
- what focus for training
- how much training.

Questions of materials and equipment pose a range of problems which are essentially separate one from another, but which are also interrelated in often quite complex ways. The report considers helpful to identify three

essential components of NICT systems as encountered by users:

- the hardware, i.e. the actual equipment, be it computer, satellite receiver, modem or whatever
- the software, i.e. the programs available to run on the hardware
- the operating environment.

On these aspects, some comments are made regarding national conditions in the UK and France, a rapid hardware development, and some questions connected with the software availability. The report stresses the importance of operating environment since it creates conditions under which the user encounters the technology.

Finally, the report focuses upon some aspects of current Group activity and identifies some lines for further development. Much has been learned, and above all it has become very clear that the NICT are not a phenomenon that can be treated in isolation within the confines of any one national system of education. It is evident that the general principles which determine the potential of the NICT for education are the same the world over and that there is a very strong case for the maximum collaboration between educational systems in respect of responses to the challenges of the NICT and cost of their realization. The report is accompanied with an extensive bibliography.

OLIVER, R. (Western Australian College of Advanced Education)
The impact of informatics on teacher training in Australia. 29 p., 2 appendices. - Bibl.

The introductory part of this report describes the nature of the Australian educational system. It is highlighted that each state and territory is responsible for its own educational policies, and that was why the early development of computer education differed significantly from state to state.

The first part gives a survey of the concept of universal computer literacy initiated by the Commonwealth Computer Education Project aimed at ensuring minimal levels of computer education being reached in all states and territories in both government and non-government schools. The goals of the project and funds allocations were aimed at the following purposes:

- professional development
- curriculum development
- software and courseware
- hardware
- support services
- evaluation.

The computerization of Australian schools is ensured by Australian companies. Some data are given about computers in Australian government schools. The overview of using computers in different kinds of schools and for what purposes is presented. The forecast is expressed as to the future development.

The third part describes new training needs of teachers. The "computer literacy" is divided into acquiring knowledge, skills and attitudes. All these parts are explained. Next, the new pre-service training needs as well as needs in in-service training are presented, and necessary suitable courses are described.

The fourth part contains a description of the present state of informatics in teacher training and all related apsects: the teaching in teacher training institutions, the pre-service teacher training awards along with individual types of courses, the teacher higher studies (individual possible courses). The contents of the courses have changed over the past years as a consequence of the development of applications of informatics in schools.

The fifth part of this report is devoted to informatics in teacher training institutions in the future. The place of informatics in teacher training institutions of the future will be affected by many factors; some of them are also described and explained. The marked development will also affect the content of teacher training courses and teaching methods.

The final sixth part of the report comprises considerations on specialized teacher training and education for teachers who are responsible for teaching informatics, for teachers who are non-computer trained, as well as for all teachers.

The report is accompanied with bibliographic references and two appendices that show a list of courses for different teachers and with different objectives. The courses range from the courses for general subject teachers to computer studies teachers.

PACENA, R. - WALSH, G. (Hochschule Lüneburg, FRG)
Studies on the impact on educational personnel training of the introduction of informatics in general education. 19 p. - Bibl.

The report is intended to give an overview of the state in informatics education in the FRG. Its introductory part presents a historical survey of the topic supplemented with statistical data about how schools in individual states were equipped with computers.

The second part describes the national strategy governed by the Bund-Laender-Kommission (BLK) expressed by a plan for the introduction of information technology in schools and vocational schools in the FRG. The main objective of this plan is to give the students of all types of schools (boys and girls) instruction about the chances and possibilities connected with modern information technology. Informatics is no longer to be viewed as a discipline isolated from all other subjects except for the upper forms of secondary schools. There is a shift from the traditional orientation towards the humanities to computer science and informatics. There are very pragmatic reasons for changing the educational goals, introducing an information technology syllabus and for actual using computers in schools: it is more or less certain that by 1990 about 70% of all people at work will be affected by computers. Each state is going its own way in implementing the following proposals of the BLK:

- a basic education in computer science
- an andvanced education in computer science (informatics)
- education in computer science at vocational schools.

A table is presented showing what sort of curriculum and which teaching organization in various school types are planned in all states of the FRG. According to the recommendations of the BLK computers should be used in schools

- as a tool to work with application programs and to solve technical and scientific problems with a help of special programming languages
- as a medium for demonstration and simulation of scientific processes and for drill and practice programs

- as a subject of discussion at school with regard to the possibilities and dangers of computers for society
- in addition, computers are to be used for school administration.

There are also strict directives as to computer configuration, its location and the software. It should be pointed out that no proper curriculum of computer science exists at the moment. Despite this fact, schools are being equipped with computers, although no one is quite sure what the students and teachers are expected to do with them.

The following part of the report deals with teacher training including necessary syllabus. Considered is also the content of the training by individual subjects. Next, a description of the initial and in-service training is given with an analysis of the school conditions and teachers' attitudes. Very often these attitudes are negative. Some of the reasons for this are:

- fear of all kinds of technology
- ignorance of the opportunities available
- lack of interest
- rejection of technology as a matter of principle
- not yet compulsory study courses and examinations.

Further on, some details are given dealing with the preparation of educated staff, including in-service training and university study of specialized informatics courses.

The final part of the report contains a survey of the ways of how teachers on different levels are trained in computer science. At the end of this report a short bibliography is appended.

a sufficient variety of educational software available at the beginning of the 90's. Its main objective is to complete the process of transferring all senior form students to the common course with obligatory employment of standard school computers assisted by properly educated teachers. The third stage will be distinguished by a wide application of information technology and wider use of computers practically in all subjects.

In the field of educational personnel training, types and forms of courses are given along with the time schedule of individual educational stages and numbers of teachers to be trained. There are three stages in the educational personnel training programme. The educational process is supported by computer centres and laboratories, universities and teacher training institutions of higher education.

The study goes on with the presentation of specialized courses as to their contents, objectives, time schedule and the way of teaching. The stress is laid on practical skills as to the employment of those features of microcomputers and microprocessors that make them useful form many professions. A syllabus containing informatics methodology is available at each course. The microcomputers will also condition the use of audio-visual aids and solving many problems connected with technical aids. In general system of audio-visual aids for school teaching , the stress is now put on standard computer-aided classroom (CAC) that is discussed in the study in detail along with the courseware (all educational and didactic tools for modern teaching). The last part of the Soviet study is devoted to the description of the courses in the three stages and in the advanced teacher training as a part of a continuous education. Also the preliminary results and prospects for the future are presented.

STANČEV, Ivan - SENDOV, Božidar (Higher Institute of Economics; Bulgarian Academy of Sciences, Sofia, Bulgaria)
The impact of educational personnel training for the introduction of informatics in general education in Bulgaria. June 1987. 18 p. - Bibl.

The first chapter of this report deals with the national strategy of the Peoples' Republic of Bulgaria for the introduction of computers in secondary schools, which comprises:

- accelerated laying of material and technical foundations according to model projects for equipment of computer classes and local networks of personal computers and considering the level, type and specialization of schools. Also the plan is presented regarding the number of computers used.
- training and qualification of teachers according to the preliminary programme of in-service education of educational personnel responsible for school courses including the institutions intended to carry out the courses, numbers of teachers and the remuneration system
- pedagogical training on computer employment and programming, being divided into two parts:
  - specialists who will use computers professionally
  - all students as potential users of computers.

  A list of schools responsible for that is presented.

The introductory part of the report contains further the history of specialized training in Bulgaria, and gives a thorough survey of the structure and contents of available courses and printed materials. Also the objectives of these courses are presented. All the activities connected with the above-mentioned courses and education are supervised by the government according to a complex programme for implementation of computer technology in secondary schools, the objectives of which are given as well. While working out the programme, the following facts were paid special attention:

- the problems connected with the wide application of computer technology in eductaion
- the necessity of developing students' world outlook for new ways of thinking and consequences of using computers in socio-economic spheres.

The next parts of the report are devoted to the organization and administration of training given by the complex programme of introduction of computers in the process of education which is linked with some other programmes of educational nature. The organization of qualification courses is, according to the programme, divided into four levels the description of each is also given. In addition to this, the necessary prerequisites as to the technical equipment and manuals or textbooks are also stated. The information is supplemented with statistical data about teachers trained in the years 1985-1986.

The final chapter of the report deals with anticipated results and consequences and development prospects.

The report is accompanied with a short bibliography.

TUCKER, Richard N. (Nederlands Instituut voor Audio-visuele Media, the Netherlands) on behalf of the International Council on Educaional Media (ICEM) Studies on the incidences of the training of educational staff for the introduction of information technology into general education. A study under contract with Unesco. March 1987. 16 p.

The Introduction and Terms of Reference parts of this report make a basis for the framework used for subsequent discussions on the given topic. In the report, informatics is emphasized in this context as the use of computers in schools. In addition to this, informatics should be viewed also as a tool for educational development as well as the aid in the preparation of teacher's work. Next, the role of informatics in the training of teachers must be considered: what impact does it have on the contents of eductaion, the methods and the organization of education in teacher training establishments; what are the new needs and training materials for all teachers in training; whether it be pre- or in-service training; what steps can be taken to satisfy these needs? The Terms of Reference also gives an overview of the countries that have responded to the questionnaire sent them for obtaining information on the topic. As a result of this, there is enough evidence from a sufficiently wide range of countries to draw some general conclusions.

. In all developed countries and also increasingly in developing countires, the computer in all its forms from mainframe to micro has penetrated the society in a remarkable way. This fact becomes a moral imperative for teaching today's students the role and function of the computer.
. There is the necessity in the study of computers as an integral part of the curriculum. In its broadest application this finds form in the general Information Technology course which sets out to teach the students the place of the computer in society. In some countries it is considered to be imperative that all students should learn to write one or more of the simpler computer languages, and thus have introduced computer studies as a separate subject. However, it becomes questionable as to whether the students should learn to write programmes in the future. This fact strongly influences the contents and methods in curricula for its implementation in education within the next year or two.
. Despite some constraints and national peculiarities as to the use of computers and appropriate education, it is obvious that in most countries there is a political will to make computer courses succeed. It is less clear, however,

whether there is the same sort of political support for the integration of computer into general education. National plans put forward in some countries are by their nature political and supportive national industries.

In the context of computer education in general, a thorough analysis is made on wha. programs are suitable for the educational purposes from different points o. view. It is concluded that the quality of software and ways of using it cha.ges the traditional role of the teacher as sole purveyor of facts or "th truth" into one of guide and mentor, simulator and helper. Key skills have to be therefore developed, such as inter-personal skills, group management and increasingly more important the skill of detailed evaluation of students progress.

. . The combination of the various programs and roles of the teacher is described by means of interlocking triangles diagram that allows to evaluate mutual relations. The first triangle represents the types of software - drill and practice, tutorials, simulations and applications. The order expresses the amount in which they are found on the market; drill and practice programs being most frequently found. As to the software, there is a radical shift taking place from programs designed for education by business to the educational use of content-free programs designed for business. The second, inverted triangle expresses the effect of the software on the teacher's role that is most important in the case of applications programs. The third triangle represents the way that teachers, through either training or experience, use programs. Thumping majority of use has been of the simple drill and practice programs. The fourth, inverted again, triangle expresses the desired amount of training and use. The greatest amount desired is for applications programs.

Finally, in the background for further considerations, an analysis is made on the use of suitable software for educational purposes from the cost-time point of view combined with objectives to fulfil the needs.

The rest of the paper is devoted to short answers provided by the correspondents and intended only as broad brush strokes to provide an overview of the situation in educational efforts in various countries. These answers responded to the following questions:

- Is there any national plan for the provision of computers in school?
- What proportion of the schools have computers?
- What sorts of somputers are used?
- Where is the computer situated?
- What training is there for the specialist and non-specialist teachers,

and what incentives are available?

- What role do the inspectors, advisers, supervisors and directors of colleges play in this development?
- Scale and content of the courses for the non-specialist teachers?
- Research to determine the effectiveness of the teacher training programs for the specialist and general education teachers?

As a summary based on these brief answers it could be stated that there is a considerable activity in countries ranging in size from Iceland to the United States of America. Each country has sought its own solution within the structures, laws and practices which form that system. Though some countries have a many-year experience with computers in the classroom, and others are just making their tentative first steps, a number of factors seem to be common. There are, however, many other factors at work (e.g. computer incompatibility) that set barriers against more uniform training materials. It is perhaps too idealistic to wish for European or world standardization. But even a common operating language for the majority of educational applications would be a great leap forward.

VERGNES, R. (Université de Droit, d'Economie et des Sciences d'Aix-Marseille; Centre d'Informatique Sociale de Salon de Provence, France)
Les incidences pour la formation des personnels de l'éducation de l'introduction de l'informatique dans l'enseignement général. Etude réalisée a la demande de l'Unesco dans le cadre de la préparation d'un séminaire international, prévu pour l'année 1987. 73 p. - 8 annexes, bibl.

This French study defines the existing condition as the starting point for the subsequent consideratons. It distinguishes groups of informatics: pedagogical informatics, user informatics and cultural informatics. These groups are constituent parts of the informatics as a branch of science.

The study goes on with the definition of fields of new technologies employment regarding the above-mentioned groups and determines the basic requirements for hardware, software, and pedagogical methods necessary to comply with the given objective: to give teachers and students sufficient knowledge and skills needed for their future real life.

From this point of view, the hardware must correspond to actual trends and anticipated advancement of technology that will face its future users. The software must assist in the educational process as a tutorial, simulation and training implement. The stress is laid on the computer assisted employment of data bases. Considered is not only the education of teachers or students, but also the necessary preparation of teachers of various levels of educational system in France.

There is a concrete educational goverment-given plan in France that fixes the needs and objectives in the field of informatics and new technologies employment as well as the ways of how to achieve these objectives. The objectives are a constituent part of the general prognosis of future development in France regarding social, economic and cultural environment. Teachers on all levels must be able to:

- develop necessary courses in the field of informatics for both students and adults
- integrate in these courses the employment of software for educational objectives with the determination of its impact on methods and contents of the subject
- present actual applications connected with a taught subject to frequenters of the courses
- present consequences and implicaton of further development of informatics to frequenters of the courses and especially in the subject taught and, if need be, the economic, social and cultural applications of the subject

- realize some actions in hardware maintenance in order to increase its utilization.

Teachers must also be able to:
- operate microcomputers regardless of their type
- load the operating system
- use basic operating system commands and service programs, and to create and use batch files
- use appropriate programming language
- use programs stored on diskette and accompanied with a brief description
- use the keyboard and to manipulate diskettes.

Finally, teachers must be able to:
- formulate problems clearly and precisely
- analyze the formulated problems and set the method of solution
- program the solution method in a programming language
- convert the program in other programming languages by means of a minimal documentation, and translate tables as needed by the educational process
- understand and use the notion "data file" through a simple excercise
- use printer for educational purposes
- understand error messages and recover from the error conditions they mean
- modify data files
- locate and remove simple hardware malfunctions.

The next parts of the study deals with methodological aspects of the educational process regarding the objectives and skills of teachers needed, and gives a survey of educational institutions responsible for informatics education including the time schedules of the courses.

The last part (appendices) of the study is devoted to the historical development of informatization of the educational system in France, to its presence and the planned future documented by statistical data. The study is accompanied with a bibliography.

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